

such work in the French or English languages, while there are only two in German. He proposes a work in three parts: (i.) historical introduction, (ii.) the electrical field of the atmosphere, and (iii.) ions, ionisation, and radio-activity. Part i. has now appeared, and if it may be taken as a fair sample of the whole, we may expect a very welcome addition to the literature of the subject.

M. Chauveau commences his history with the celebrated letter from Franklin to Collinson (dated 1750) in which the great American philosopher suggests a method for testing the hypothesis, then fifteen years old, that thunder and lightning are electrical phenomena. From this commencement the following stand out as the milestones along the path of progress:

(1) The proof that thunder and lightning are electrical phenomena: Dalibard, May 1752; Franklin, June 1752.

(2) The discovery of the electrification of the atmosphere with clear skies: Lemonnier, Sept.-Oct. 1752.

(3) The discovery of the daily variation: Beccaria, 1753-1775.

(4) The discovery of the annual variation: De Saussure, 1785.

(5) W. Thomson's (Lord Kelvin) improvements in instruments and methods, and the introduction of the idea of electrical potential gradient: 1856-1874.

(6) The discovery of the conductivity of air: Linss, 1887; Elster and Geitel and C. T. R. Wilson, 1899.

(7) The discovery of "atmospheric radio-activity": Elster and Geitel, 1902.

(8) The discovery of a very penetrating radiation in the upper atmosphere: Hess and Kolhörster, 1911-1914.

In telling the story of the progress from milestone to milestone, M. Chauveau has related the history of the development of instruments and methods and described the many attempts to find physical explanations of the phenomena observed. At first the observations were made with insulated conductors, generally pointed, from which sparks were drawn, but Lemonnier tested the electrical state of his "collector" by noting whether it attracted powder, and by this relatively delicate method he first detected "fine weather electricity." Later rough electroscopes, fitted with pith balls or gold leaves, made quantitative measurements possible, and so led to the determination of the diurnal variation by Beccaria. With electroscopes it was possible to detect a change in the electrical state of an insulated conductor as it was raised and lowered in the atmosphere (induction effect), and De Saussure used this method with remarkable results in 1785. It was with the discovery of "the power of the flame" to charge a conductor

exposed to the atmosphere, which Volta made about 1780, that trustworthy methods became possible, but this discovery remained practically unused, and it was not until W. Thomson took up the study of atmospheric electricity some seventy years later that measurements were put on a sound physical basis.

Hypotheses and theories to explain the observations are innumerable: Volta's theory of the separation of electricity on evaporation; Peltier's theory of a permanent negative charge on the earth's surface, partially dissipated into the atmosphere by evaporating water and returned on condensation; Sohneke's theory of friction between water and ice; and Brillouin's theory of the electrical separation caused by ultra-violet light falling on the ice crystals of cirrus clouds; these are the most important. But every theory to explain the maintenance of the earth's electrical field has failed, and we appear to-day to be further from an explanation of this fundamental phenomena than we have been at any previous time. Even now we do not know whether the earth with its atmosphere is electrically neutral or whether there is a residual charge, and at the present moment there is not a single theory seriously maintained to explain the constant interchange of electricity between the earth's surface and the lower atmosphere.

G. C. S.

Forest Policy and Management.

(1) *Schlich's Manual of Forestry*. Vol. 1: *Forest Policy in the British Empire*. By Sir William Schlich. Fourth edition, revised and enlarged. Pp. xi + 342. (London: Bradbury, Agnew and Co., Ltd., 1922.) 15s. net.

(2) *The Practice of Silviculture: With Particular Reference to its Application in the United States*. By Prof. R. C. Hawley. Pp. xi + 352. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1921.) 22s. net.

(3) *Forest Mensuration*. By Prof. H. H. Chapman. Pp. xxii + 553. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1921.) 30s. net.

(4) *A Short Manual of Forest Management*. By H. Jackson. Pp. x + 70. (Cambridge: At the University Press, 1921.) 7s. net.

SIR W. SCHLICH has crowned a long life of devotion to the science and art of forestry by the publication of what is practically a new work, although it purports to be only a new edition of vol. 1 of his well-known Manual. (1) This volume is certainly the most valuable book on the economics and the history of British forestry that has yet appeared. It should

prove interesting to the statesman and the economist, as well as to the forester and the industrialist.

The first part treats of general principles. The utility of forests is considered directly, when concerned with actual products, such as timber, turpentine, tans, etc.; and indirectly, when it is a question of the influence of forests on climate, soil erosion, hygiene, æsthetics and ethics. The last three are more important than is generally believed; and Sir William pleads for the creation of woodlands near large towns, which will serve as recreation grounds for the people and at the same time produce timber finding a ready sale, so that the establishment of these city forests need not be a financial burthen. Glasgow, renowned for its municipal enterprise, is the first of our cities to acquire a forest area for the enjoyment of its inhabitants, the Ardgoil Estate.

After the subject of the State in relation to forests is discussed, the remainder of the book, some 300 pages, deals with the actual condition of forestry in the British Empire. The British Isles, India, Canada, Newfoundland, South Africa, New Zealand, and the Crown Colonies are treated separately. The natural history of the forests, their resources in timber, the modes of silviculture, government policy, education, etc., are all carefully described, sketch maps and statistical tables being added where required.

(2) Considering the vast amount of information on the practice of silviculture which is scattered in British and American forestry journals and official bulletins, it is remarkable how few formal text-books on the subject have been published in English. The present work by a Yale professor is therefore very welcome. It deals primarily with conditions in the United States; but as the principles of silviculture are the same everywhere, the book can be used by British students with scarcely any change or comment. It is a compilation, remarkably up-to-date, and rendering matter available for study which otherwise could be found only by long search in German and French books. The author's presentation of facts is clear, and well illustrated by suitable diagrams.

There is, however, one serious defect, the omission of the subject of reproduction of the forest by artificial means, the reader being referred for information on this point to "Seeding and Planting," a companion book by Prof. Toumey, also of Yale University. Artificial planting of trees is much more common with us than natural regeneration; and the necessity of using another book will be irksome to British students. Prof. Hawley's exposition of the methods of natural regeneration is excellent; but the best chapter in the book is one dealing with "thinning," a difficult subject. Another subject, also treated in a fresh and original

manner, is the disposal of the "slash" or rubbish which is left on the ground after felling operations. This is important, as on the removal of the "slash" depends in great measure the freedom of the forest from injury by fire, insects, and fungi. General measures of protection against these three agents of destruction, as well as damage caused by grazing, are treated in four short chapters.

An excellent feature of the book is an appendix of more than forty pages on terminology, which is really an alphabetical list with definitions of the terms used in the science and art of forestry. This glossary, which was drawn up in 1917 by the Society of American Foresters, will serve to stimulate accuracy of statement by foresters. German and French equivalents are given.

(3) Prof. Chapman's "Forest Mensuration" is the third text-book on forest mensuration which has appeared in English, and it is well designed to become the standard authority on the subject in the United States. The system of measuring timber in North America is totally different from ours. There, the contents of trees and logs are expressed in terms of the probable out-turn in sawn boards, according to a certain log-rule; hence the phrase "board feet." In the British Isles timber is measured as a raw material in terms of the real cubic volume. The American system introduces extraordinary complication into forest mensuration, some thirty log-rules being now in use in different parts of the country, no two rules giving the same result in board feet. A considerable part of the book is taken up with these log-rules and the principles underlying their construction—all of which is useless to the forester in Europe or India.

Nevertheless, a large part of the volume is of interest, for once log-rules are disposed of, the author is on common ground with his European fellow foresters, and gives a good account of recent developments of forest mensuration by Swedish and German writers. The accurate measurement of masses of standing trees is difficult, but is obligatory for purpose of valuation, and is of great use as a means of determining from time to time the increment of a growing wood. Upon a knowledge of the latter depends the fixing of the proper time for felling. Part III. deals with the laws of growth of stands of trees, and is by far the most interesting subject discussed, as the principles involved are the same in all countries where scientific forestry is practised. The preparation of yield tables and their application to predicting future yields are treated fully. The book will be useful in the reference library, but cannot be recommended as a handbook for British students, on account of its preoccupation with American practice.

(4) Forest management is little understood in the

British Isles, where owners of woods usually confine their attention to the practical work of planting, thinning, and felling trees, without having clear ideas of the financial problems involved. The objects of management are classified as being either physical or economic. The former apply to protection forests, maintained on mountain slopes to prevent erosion and mitigate disastrous floods, to forests on catchment areas that afford water supplies to towns, and to private woodlands on estates which are treated as amenity grounds for ornament and sport. An economic object of management applies to any forest worked for timber and other saleable products. Forests of this kind are commercial undertakings, and the scheme of management adopted here should be such as to render the woodlands a financial success, yielding the maximum soil rental and giving the highest net return on the capital involved. The principles underlying forest management are clearly explained in Mr. Jackson's little book, which can be recommended as an introduction to this important subject.

Thoughts on Scientific Advance.

Problems of Modern Science. A Series of Lectures delivered at King's College (University of London). Edited by Prof. Arthur Dendy. Pp. 237. (London: G. G. Harrap and Co., Ltd., 1922.) 10s. 6d. net.

THE object of this series of lectures is stated to have been to "place before the general public the present position of some of the main branches of science and to point out the direction in which progress is being made or may be hoped for in the near future." The book will also be found useful by scientific workers who desire to know something of the advances made in regions other than their own. The names of the lecturers are a sufficient guarantee of the value of the matter presented. It is unfortunate that no index is provided, and, for this reason, perhaps the most useful function of a review is to give some indication of the contents of the book. But it is to be understood that the topics mentioned by no means exhaust the list.

Prof. Nicholson's lecture on mathematics shows that much more research work is possible in that science, and it gives a useful account of the quantum theory. In Prof. Dale's astronomical lecture, we find a summary of the present position of the nebular hypothesis. It is interesting to find that certain kinds of nebulae may reasonably be looked upon as bye-products of evolution. Prof. Richardson gives us a valuable general account of the latest views on the structure of atoms, and also further statements with regard to the quantum theory.

Prof. Smiles refers especially to the chemistry of plants.

Prof. Dendy's lecture is an interesting discussion on the various component sciences making up that of general biology. A remark on page 131 with reference to the widespread influence of physiological considerations may be noted—"It is perhaps unfortunate that our interest in ourselves as human beings has resulted in the concentration of attention upon the functions of the human body, almost to the exclusion of the lower animals, so that the development of this branch of Biology has been a very lop-sided growth." It is to be hoped that recent developments, especially at the Plymouth Marine Biological Station, will remedy this state of affairs.

Prof. Ruggles Gates deals with various botanical problems, more especially with those of genetics and mutations. Prof. Halliburton is mainly concerned with pointing out the importance of free fundamental research in physiological science and gives various examples where important practical application at a later date was quite unforeseen. Prof. Barclay-Smith devotes his lecture to a useful account of the formation of bone, which presents phenomena of much greater general interest than some would be inclined to suppose.

The book may be thoroughly recommended, and the price is not excessive in comparison with many scientific works at the present day. W. M. B.

Our Bookshelf.

The Newcomen Society for the Study of the History of Engineering and Technology. Transactions, Vol. 1, 1920-1921. Pp. 88+18 Plates. (London: The Newcomen Society, 1922.) 20s.

IN technology as well as in science the value of a knowledge of the history belonging to a given subject is gaining recognition. One result of the celebration at Birmingham of the centenary of James Watt in 1919 was the formation, by a few engineers interested in historical research, of the Newcomen Society, and the first volume of the society's Transactions has recently been issued. As indicated in its sub-title, the object of the society is to encourage the study of the history of engineering and technology, and it is, we believe, the first society formed for such a purpose. It takes its name from Thomas Newcomen (1663-1729), the Dartmouth blacksmith to whom we owe the atmospheric steam-engine. The honorary secretary and treasurer of the society is Mr. H. W. Dickinson, of the Science Museum, South Kensington.

Besides the papers read during the session 1920-21, the volume under notice contains the first presidential address, a list of members, the rules and constitution, and an account of the first summer meeting. Mr. Titley, in his address, after giving a brief sketch of the steps leading to the formation of the society, passes in review the subjects which come within its scope, points